FLUID-DISPENSER DEVICE CONDUCIVE TO REDUCED WATER CONSUMPTION IN A WASHING MACHINE

BACKGROUND OF THE INVENTION

[001] This invention generally relates to washing machines, and, more particularly, to a fluid-dispenser device for washing machines.

[002] A typical washing machine may have a water dispensing spout which generally dispenses water at a fixed location with respect to a bundle of articles, e.g., clothes, that may be widely scattered over the interior of a wash basket during washing and rinsing operations. This may result in just a small-localized fraction of the overall clothes volume getting appropriately soaked under running water while most of the dispensed water initially reaches the bottom of a tub, part of which first fills an annular space between the basket and the tub, causing a delayed and gradual soaking of the clothes from bottom to top with the rising water level.

[003] The rising water level and any buoyancy resulting from entrapped air cause the clothes to move upwards and float, which results in a relatively slow soaking rate and just the partial submerging of the clothes in the rising water, thus requiring relatively higher quantities of water to ensure appropriate wetting of the clothes. The additional water may also necessitate extra mechanical efforts during rotation of an agitator in the wash basket and/or rotation of the wash basket.

[004] At the end of a centrifugal spin-extraction process in a typical vertical axis washer, the clothes typically get densely stacked around the vertical sidewall of the basket. Smaller and medium clothes loads may form a lower stacked bundle around the basket sidewall, and this bundle makes poor or no contact with the water column emerging from the spout, thus requiring relatively large quantities of water during a rinsing operation.

[005] During a washing operation, the user may desire to add various cleansing and/or conditioning agents directly into the basket, which may result

in a localized dispensation of such agents relative to the scattered clothes, thus requiring burdensome efforts to evenly apply the washing agent across the entire volume of clothes. This localized dispensation may also cause overexposure of the localized small portion of clothes to a concentrated washing agent, which could have an adverse impact on the fabric materials.

BRIEF DESCRIPTION OF THE INVENTION

[006] Generally, aspects of the present invention fulfill the foregoing needs by providing a fluid-dispenser device for a washing machine having a wash basket movable about an axis and defining radii extending in a horizontal plane relative to a circumference in correspondence with respect to the wash basket. The device includes at least two outlet ports positioned to direct respective jets of fluid into the wash basket. Each of the jets may have a distinctive exit angle relative to a respective radius in said horizontal plane and passing through the respective outlet ports. In another aspect thereof, each of the jets may have a generally parallel relationship with respect to one another.

BRIEF DESCRIPTION OF THE DRAWINGS

[007] FIG. 1 is a perspective cutaway view of an exemplary washing machine.

[008] FIG. 2 is a schematic block diagram of an exemplary control system for the washing machine shown in FIG. 1.

[009] FIG. 3 illustrates a top view schematic for visualizing details in connection with a fluid-dispenser device for a washing machine.

[010] FIG. 4 illustrates a top view schematic of an exemplary fluid-dispenser device in the form of a pressurized annular ring.

[011] FIG. 5 shows an exemplary construction of an individual segment, as may be used for constructing a segmented annular ring for dispensing fluid.

[012] FIG. 6 illustrates an isometric partially cut-away view of a wash basket in combination with a fluid-dispenser device configured as an annular ring.

DETAILED DESCRIPTION OF THE INVENTION

[013] FIG. 1 is a perspective view partially broken away of an exemplary washing machine 50 in which aspects of the present invention may be practiced. It is recognized, however, that the various benefits of the present invention may be demonstrated in other types of washing machines. The description of washing machine 50 below is therefore offered just for illustrative purposes, and in no way should be construed to limit application of the present invention in any aspect.

[014] Washing machine 50 includes a cabinet 52 and a cover 54. A backsplash 56 extends from cover 54, and a variety of appliance control input selectors 60 may be mounted onto backsplash 56. Input selectors 60 comprise a user interface for operator selection of operational machine cycles and modes of operation. A lid 62 is mounted to cover 54 and may be movable between an open position facilitating access to a wash tub 64 located within cabinet 52, and a closed position forming a covered enclosure over wash tub 64.

[015] Tub 64 includes a bottom wall 66 and a sidewall 68, and a basket 70 may be rotatably mounted within wash tub 64. A conventional agitator, impeller, or oscillatory basket mechanism may be disposed in basket 70 to agitate the articles and liquid in basket 70. The agitator and/or wash basket may be positioned to rotate or otherwise have motion, e.g., oscillatory or wobbling motion, about an axis, such as a vertical axis or an axis with some degree of tilt.

[016] As seen in FIG. 2, operation of machine 50 may be controlled by a controller 138 that is operatively coupled to the user interface input mounted on washing machine backsplash 56 (FIG. 1) for user manipulation to select washing machine cycles and operational modes. In response to user

manipulation of the user interface input, controller 138 may operate various components of machine 50 to execute any selected machine cycles and operational modes.

[017] In an illustrative embodiment, clothes are loaded into basket 70, and a washing operation may be initiated through operator manipulation of control input selectors 60 (FIG. 1). Tub 64 may be filled with water and mixed with detergent and optionally with other cleansing and/or conditioning agents, e.g., bleach, to form a wash fluid, and the fluid and clothes therein are agitated by the agitator for cleansing the clothes in basket 70. After a period of agitation, tub 64 may be drained with a suitable pump assembly 72 (FIG. 1), and basket 70 may be spun to extract wash fluid from the clothes. Clothes may then be rinsed with fresh water and basket 70 may be spun again to remove water from the clothes. Depending on the particular wash cycle selected, multiple wash and spin portions of the wash cycle may be executed.

[018] FIG. 2 shows a schematic block diagram of an exemplary washing machine control system 150 for use with washing machine 50. Control system 150 includes controller 138 that may, for example, comprise a microcomputer 140 coupled to a user interface input 141. An operator may enter instructions or select desired washing machine cycles and features via user interface input 141, such as through input selectors 60 (FIG. 1). A display or indicator 144 may be coupled to microcomputer 140 to display appropriate messages and/or indications, such as elapsed time, and other data that may be of interest to washing machine users. A memory 142 may also be coupled to microcomputer 140 to store instructions, calibration constants, and other information as may be appropriate to satisfactorily complete any selected cycle. Memory 142 may, for example, comprise a random access memory (RAM). In alternative embodiments, other forms of memory could be used in conjunction with RAM memory, including but not limited to electronically erasable programmable read only memory (EEPROM).

[019] Analog-to-digital and digital-to-analog converters (not shown) may be coupled to controller 138 to appropriately condition controller signals and provide executable instructions to generate controller outputs to various washing machine components. For example, controller 138 may be operatively coupled to a machine drive system 148 (e.g., a motor and clutch system), a brake system 151 associated with basket 70, water valves 152 and a machine drain system 154 (e.g., a drain pump assembly and/or drain valves) each according to techniques well-understood by those skilled in the art.

[020] In one exemplary embodiment, water valves 152 may be in flow communication with a fluid dispenser device 200 (shown in phantom in FIG. 2) embodying aspects of the present invention, as described below in greater detail. For example, water may be mixed with detergent or other suitable agents (e.g., softeners, whiteners, etc.) to form a fluid for cleansing and/or conditioning of the articles in wash basket 70 (FIG. 1), or fresh water may be used subsequent to a wash cycle to rinse the cleansing liquid from the garments.

[021] In response to manipulation of user interface input 141 controller 138 may monitor various operational parameters of washing machine 50 with one or more sensors or transducers 156, and controller 138 may execute operator selected functions and features.

[022] Aspects of the present invention relate to an improved filling, washing and rinsing system configured to effect efficient submerging and substantially uniform soaking of a clothes load with reduced quantity of water during washing and rinsing cycles of the washer. The operation of an exemplary system may comprise creating and targeting a well-spread array of multiple water jets towards a widely distributed load of articles, e.g., clothes, inside the basket of the washing machine.

[023] In addition, controller 138 may be configured to simultaneously command rotation of the basket at a moderate speed during a liquid filling

cycle causing the array of water jets to sweep and directly impinge on the clothes surface several times during the entire filling cycle, thus further enhancing the coverage of the clothes surface exposed to the array of water jet.

[024] In one exemplary embodiment, the washer uses the fluid dispenser device 200 for creating an array of water jets that follow desired trajectories under a wide range of varying inlet pressures, thus ensuring that a sufficient quantity of wash or rinse fluid dispensed in the washing and rinsing cycles directly reaches the clothes, without being obstructed by a stationary or moving part of the washer. By way of example, the clothes may be either widely distributed inside the basket, as in a washing cycle, or densely stacked around the basket vertical wall in a rinsing cycle.

[025] It will be appreciated that various factors, such as inlet water pressure, cross-section area and angular orientation of individual jet and the number of jets may be appropriately selected for a given application to determine the target location of the water jets over the clothes surface relative to a stationary basket. In one exemplary embodiment, the trajectories and target locations of the water jets may be made to lie on generally non-overlapping paths (e.g., parallel paths) while the basket may be rotated to broaden the coverage of the array of water jets.

[026] Furthermore, a moderate swinging motion of the basket, as may be induced, e.g., by the revolving mass of the clothes and water inside the basket or any other swinging means, would cause a random displacement of the target locations of the water jets relative to the clothes surface, thus further improving the sweeping coverage of the clothes surface impinged by the array of water jets. The well-spread array of water jets, the non-overlapping paths of the target locations of each jets as described above, plus the effect of any rotary and/or swinging motion of the basket ensure substantially faster and uniform soaking of an entire volume clothes with less quantity of water and facilitate carrying out multiple rinse operations with

lower quantities of water and with no appreciable increases in the time for performing such multiple operations.

[027] Fluid dispenser device 200 facilitates multiple rinse operations with smaller quantities of water to cause effective removal of any residual washing agents from the washed clothes load to achieve the desired rinse performance. The actual number of multiple rinse cycle and operational parameters for each of these rinse cycles, such as the speed of rotation and rotation time of the basket during filling and extraction cycles, the quantity and temperature of water dispensed during each fill operation, may be either user selected or may be automatically selected by controller 138. The selection may be based on the estimated or measured load sizes respectively.

[028] As a filling/soaking process performed by fluid dispenser device 200 progresses from top-to-bottom through the clothes volume, the clothes would become heavier with the absorbed water and would tend to move and settle towards the bottom of the basket, thus resulting in faster soaking and better submerging of the clothes during the washing and/or rinse cycles with relatively less quantity of water and mechanical efforts. For example, during each individual rinsing cycle, as the water is dispensed from fluid dispenser device 200 while the basket is spinning at a moderate speed, a meniscus of water is formed raising the water around the basket side wall thus aiding the soaking action of densely stacked clothes around the basket wall with a relatively low quantity of water. A flexible inlet hose connection to fluid dispenser device 200 would allow unimpeded movements of the dispenser device and reduce any stretching forces acting on the hose connection during random displacement of the tub with respect to the other fixed end of the inlet hose.

[029] FIG. 3 illustrates a schematic for visualizing some of the inventive aspects in connection with fluid-dispenser device 200 for a washing machine that, as described in the context of FIG. 1, may have a wash basket movable about an axis 202, e.g., a vertical axis or an axis having some degree of tilting. The wash basket may define radii, such as radii 204 and 206

extending in a horizontal plane relative to a circumference 208 in correspondence with respect to the wash basket. It is noted that circumference 208 need not physically align with the circumference of the wash basket. In one exemplary embodiment, fluid-dispenser device 200 may comprise at least two outlet ports, such as outlet ports 210 and 212 positioned to direct respective jets of fluid into the wash basket. Each of the jets may have a distinctive exit angle, such as exit angles α and β relative to a respective radius in the horizontal plane that passes through the respective outlet ports, such as radii 204 and 206. By way of example, as shown in FIG. 3, outlet ports 210 and 212 may be situated at different points along the circumference in correspondence with the wash basket.

[030] In an alternative embodiment, the outlet ports, such as ports 220 and 222 may be situated at different points along a common radius 224. As shown in FIG. 3, outlet ports 220 and 222 may be situated in a common plane, or could be in different planes, as would be the case if ports 220 and 222 were to be stacked positioned one beneath the other along corresponding radii. It will be appreciated that each of these embodiments allows configuring the jets to have a generally parallel relationship with respect to one another.

[031] As shown in FIG. 4, fluid-dispenser device 200 may comprise a pressurized annular ring 230 made up of multiple sets 232 of at least two adjacent ports distributed along the circumference in correspondence with the wash basket. In one exemplary embodiment, each jet in a set may be configured to have a distinct exit velocity. This effect may be substantially governed by the size of the cross section area at the exit of the outlet ports. Further, each jet or outlet port in a set may have a distinct inclination angle with respect to the horizontal plane, such as downwardly (positive), zero or upwardly (negative) inclination. These configurations may be provided individually or in any combination with the distinctive exit angle configuration described in the context of FIG. 3

[032] As shown in FIG. 4, each of the multiple sets of adjacent ports may be equidistantly distributed along the circumference in correspondence with the wash basket. Pressurized annular ring 230 may be a segmented annular ring, a branched network, such as made up of a network of spaced-apart discrete components or may be constructed as a single-piece ring. FIG. 5 shows an exemplary construction of an individual segment 234. Annular ring 230 includes fluid conducting means 236 for passing pressurized fluid from an inlet port 238 to the outlet ports therein. It will be appreciated that multiple inlet ports may be provided in fluid dispenser 200 to feed different fluids simultaneously or selectively during any given operating cycle. Controller 138 may be configured to control the selective passing of any such different fluids. By way of example, the fluid dispensed at desired times through fluid dispenser 200 while performing an operational cycle, e.g., wash or rinse cycle, may comprise fresh water alone or in combination with other fluids or may comprise re-circulated water alone or in combination with other fluids.

[033] In one exemplary embodiment dispenser 200 may comprise a fluid pressurizing device 239, e.g., a suitable pump, as may be integrated within the dispenser or externally to obtain a desired effect to fluid passing through the dispenser. In addition, a pressure regulating device 242, e.g., a suitable pressure regulator or accumulator, may be integrated within the dispenser or externally to maintain a desired level of pressure to fluid passing through the dispenser. A flow regulating effect or device 244, such as one or more variable area valves, may be integrated within the dispenser or externally to achieve a desired amount of flow to the fluid passing through the dispenser. It will be appreciated that the foregoing devices may be optionally coupled individually or in any desired combination, depending on the fluid dispensing requirements of any given application.

[034] FIG. 6 illustrates an isometric partially cut-away view of wash basket 70 in combination with a fluid-dispenser device configured as annular ring 230. Exemplary target locations 240 impinged by the water jets from the fluid dispenser device may be appreciated in FIG. 6. In operation, fluid dispenser

device 200 allows delivering a lesser amount of fluid than would otherwise be required to fill the wash basket to sufficiently wet any that may be articles positioned along the sidewall of the basket. It will be appreciated that a fluid dispenser device embodying aspects of the invention is not only conducive to achieving significant water savings during a laundering process but also allows improved distribution of other cleansing or conditioning agents that may be mixed with the water.

[035] An experimental comparison of dilution of a substance (e.g., NaCl) that may be analogized to the presence of detergent in clothing was performed in single and multi-stage sequential rinsing with different volumes of water. This study suggested that relatively a higher number of rinsing sub-cycles with smaller volumes of water would perform superior rinsing than a single rinsing cycle (or fewer sub-cycles) with relatively more volume of water. This study further suggested that an approximately equal volume of water in each sub-cycle would perform at least analogously if not better rinsing compared to progressively increasing (or reducing) the respective volumes of water, assuming the same number of sub-cycles.

[036] While the invention has been described in terms of various specific embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the claims.